

इंटरनेट

मानक

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Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”

Mazdoor Kisan Shakti Sangathan

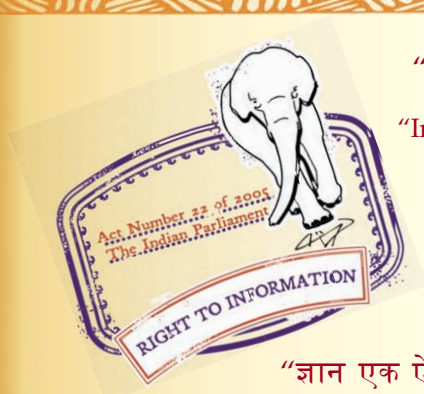
“The Right to Information, The Right to Live”

“पुराने को छोड़ नये के तरफ”

Jawaharlal Nehru

“Step Out From the Old to the New”

IS 10000-7 (1980): Methods of tests for internal combustion engines, Part 7: Governing tests for constant speed engines and selection of engines for use with electrical generators [TED 2: Automotive Primemovers]



“ज्ञान से एक नये भारत का निर्माण”

Satyanarayan Gangaram Pitroda

“Invent a New India Using Knowledge”



“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”

Bhartrhari—Nitiśatakam

“Knowledge is such a treasure which cannot be stolen”

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Indian Standard

METHODS OF TESTS FOR
INTERNAL COMBUSTION ENGINESPART VII GOVERNING TESTS FOR CONSTANT SPEED
ENGINES AND SELECTION OF ENGINES FOR USE WITH
ELECTRICAL GENERATORS

1. Scope — Specifies the governing tests for constant speed engines and the guidelines for the selection of the engines for use with an electrical generator.

2. Governing

2.1 Definitions — Following definitions shall apply.

2.1.1 Transient speed change (δ_d) — Maximum deviation of speed after sudden load change from speed at steady state level, expressed as a percentage of the rated speed:

$$\delta_d = \frac{n_{\max} - n_r}{n_r} \times 100$$

where

n_{\max} = transient speed resulting after load change on the engine, rev/min, and

n_r = rated speed of the engine as declared by the manufacturer, rev/min.

2.1.2 Permanent speed change — Deviation of speed after gradual power change from speed at steady state level, expressed as a percentage of rated speed.

2.1.3 Steady state speed band ' ν ' — Width of envelope of variation of the engine speed under steady state conditions expressed as a percentage of rated speed.

2.1.4 Recovery time — Time interval from point when speed exceeds steady state speed band after the load change until speed is set up and remains within the steady state speed band associated with the new load, expressed in seconds.

2.2 The engine shall run at a steady load within its rating.

2.3 Classes of Governing

2.3.1 Class A_1 governing — Installations where special requirements exist (such as radar, radio, computer supplies and very heavy motor starting duties), the following information shall be supplied by the engine manufacturers:

- The maximum load that can be suddenly applied to the engine while it is running at full rated speed, at no load, and at normal running temperatures;
- The transient and permanent speed changes that will result from the application of this load;
- The transient and permanent speed rise resulting from full load being thrown off;
- The transient and permanent speed change resulting from a change of load, both off and on, by steps of 25 percent of the rated full load; and
- The steady state speed band and the recovery time to this speed band from all the conditions stated above.

2.3.1.1 The steady state speed band shall not exceed ± 0.5 percent during the performance test [see IS : 10000 (Part VIII)].

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2.3.2 Class A₂ governing — The engine shall be governed within the following limits:

Load Variation at Rated Speed	Maximum Change of Speed as a Percentage of Rated Speed		Maximum Recovery Time in Seconds
	Transient		
On suddenly taking-off the rated load	Transient	15	15
	Permanent	4.5	—
On a change of load, both on and off, by all steps of 25 percent of the rated load in both directions while putting on load and while taking-off load	Transient	4	5
	Permanent	1.5	—

2.3.2.1 When the engine is delivering between no load and 100 percent of the rated power output, the steady state speed band shall not exceed ± 0.5 percent of the rated speed for Class A₂ governing. The steady state speed band shall be measured for a period of 2 to 5 minutes. The maximum and minimum speed readings shall be taken for the period of steady state speed band measurement.

2.3.3 Class B₁ governing — The engine shall be governed within the following limits:

Governed Speed (At Full Load)	Temporary Speed Change (Full Rated Load to No Load)	Maximum Permanent Speed Change (Full Rated Load to No Load)
100 percent	8 percent	15 percent

2.3.3.1 The manufacturer while tendering to Class B governing, shall state the rated speed on which the above table is based. The steady state speed band shall not exceed ± 1 percent during the performance test [see IS : 10000 (Part VIII)].

2.3.3.2 Engines with Class B₁ governors shall be provided with an external means of adjustment of running speed by ± 5 percent of the nominal speed at all loads up to the rated load.

2.3.4 Class B₂ governing — Engines conforming to this type of governing shall be governed within the following limits:

Governed Speed (At Full Rated Load)	Temporary Speed Change (Full Rated Load to No Load)	Maximum Permanent Speed Change (Full Rated Load to No Load)
percent	percent	percent
100	8	15
80	10	17
60	13.3	20
50	16	25
40	20	30
30	27	40
25	32	50

Note — All the above values are as a percentage of the engine design speed.

2.3.4.1 The manufacturer when tendering to Class B₂ governing shall state the design speed of engine.

2.3.4.2 Steady state speed band shall not exceed ± 1 percent during the performance test [see IS : 10000 (Part VIII)].

2.3.4.3 Engines with Class B₂ governors shall be provided with an external means of adjustment of the running speed by ± 5 percent of the nominal speed at all loads up to the rated load.

3. Selection of Engine for Use with Electrical Generators

3.1 *Cyclic Irregularity of Direct Coupled Engine and Electrical Generators* — For a direct-coupled engine and generator, cyclic irregularity as defined in 3.1.1 is independent of the number of poles of the generator and refers to the angular velocity at the rotor of the electrical machine.

3.1.1 *Cyclic irregularity (calculated)* — The ratio of the total variation in speed (instantaneous angular velocity) at the flywheel during one engine cycle to the mean speed when the engine is running at any load up to and including rated load and at rated speed. This is conveniently expressed as follows:

$$\text{Cyclic irregularity} = \frac{\text{Maximum speed} - \text{Minimum speed}}{\text{Mean speed}}$$

3.1.2 The maximum permissible cyclic irregularity of direct-coupled engine and generator throughout one engine cycle shall conform to the following requirements:

- For an engine having one or two cylinders, the cyclic irregularity shall not be worse than 1/75 unless a closer limit is specified to avoid flickering of lights; and
- For an engine having more than two cylinders, the cyclic irregularity shall not be worse than the following values, unless a closer limit is specified:

<i>Engine Impulse per Second</i>	<i>Cyclic Irregularity not Worse Than</i>
Less than 10	1/150
10 to 20	<u>Engine impulses per second</u> 1 500
Above 20	1/75

3.2 *Angular Deviation of Alternating Current Generators in Parallel* — The combined flywheel effect of the flywheel and alternator shall be such that the angular deviation in either direction from the position of uniform rotation shall not at any time exceed two and a half electrical degrees, in addition to complying with the limit of cyclic irregularity specified in 3.1.2.

3.2.1 The engine manufacturer shall inform the supplier of the alternator, regarding the total flywheel effect, which shall be provided, to ensure that the maximum calculated angular deviation of two and a half electrical degrees is not exceeded. He shall also state the frequencies of such engine-disturbing forces as are of significant magnitude and the supplier of the alternator shall then specify to the engine manufacturer what additional flywheel effect (if any) is necessary for avoiding the effects of resonance due to alternator swing.

Note 1 — The angular deviation specified is that calculated on the assumption that the torque of the alternator, that is, the torque opposing the motion of the engine, is uniform throughout the engine cycle.

Note 2 — The angular deviation specified applies to alternators of ordinary regulation. Alternators designed for special regulation may require still closer uniformity of rotation.

Note 3 — An electrical degree is 1/360th of a complete electrical cycle. If P = number of poles of an alternator, the number of electrical cycles in a revolution is $P/2$, so that 360 mechanical degrees correspond to $(P/2) \times 360$ electrical degrees, or one mechanical degree = $P/2$ electrical degrees.

Note 4 — By avoidance of the effects of resonance is meant that the natural frequency of oscillation of the alternator with its flywheel, when connected to the electrical system with which it is to work in parallel, shall not approach the frequency of any engine impulses of significant magnitude.

4. Torsional Critical Speeds — The main contractor (be he either engine manufacturer, builder of the driven machinery, or an independent supplier) shall be responsible for ensuring that the torsional vibration conditions of the dynamic system comprising engine and driven machinery are satisfactory.

4.1 In installations where a knowledge of the torsional vibration stresses of the complete system is required the following procedure shall be adopted for determining the torsional vibration stresses:

- a) The engine builder shall estimate by calculation the torsional vibration stresses in engine crankshaft and driven machinery shafting resulting from torsional critical speeds.
- b) The main contractor shall be responsible for ensuring that the builder of the driven machinery shall supply adequate and accurate data and plans required for the above calculations, including the dimensions, inertias, and, where applicable, torque curves. The builder of the driven machinery shall also indicate, if available, the maximum permissible torsional stresses and amplitude in the driven machinery.
- c) The engine builder shall certify to the supplier of the driven machinery (either direct or through the main contractor) the estimated values of the stresses and torques in the driven machinery shafting at all normal rotational speeds. He shall also indicate, where necessary, the estimated values of the peak stresses, the rotational speeds at which they occur, and the amplitudes in the system.
- d) If the results of the above mentioned calculations require modifications to the system, then the main contractor will arrange either with the engine builder or with the driven machinery manufacturer(s), or any necessary modifications to be made.

EXPLANATORY NOTE

The testing and performance of constant speed and variable speed internal combustion engines was earlier covered by the following Indian Standards:

IS : 1600-1960 Code for type testing of constant speed internal combustion engines for general purposes,

IS : 1601-1960 Performance of constant speed internal combustion engines for general purposes,

IS : 1602-1960 Code for type testing of variable speed internal combustion engines for automotive purposes, and

IS : 1603-1960 Performance of variable speed internal combustion engines for automotive purposes.

These standards were originally issued in the year 1960 and as a result of implementation of these standards by the manufacturers of engines and testing laboratories, as also the operation of ISI Certification Marking Scheme, these standards have now been extensively revised.

While IS : 1600 and IS : 1602 covered the codes for type testing of constant and variable speed engines respectively, the performance requirements of such engines were covered by IS : 1601 and IS : 1603, respectively. These standards are replaced by two sets of standards, one set covers the methods of testing of engines and the other covers the specification and performance requirements of both constant speed and variable speed engines.

The standard covering methods of tests is being published in following 12 parts (each part covering a particular test method or information related to methods of tests):

IS : 10000 Part I Glossary of terms relating to test methods

IS : 10000 Part II Standard reference conditions

IS : 10000 Part III Measurement for testing, units and limits of accuracy

IS : 10000 Part IV Declarations of power, efficiency, fuel consumption and lubricating oil consumption

IS : 10000 Part V Preparation for tests and measurements for wear

IS : 10000 Part VI Recording of test results

IS : 10000 Part VII Governing tests for constant speed engines and selection of engines for use with electrical generators

IS : 10000 Part VIII Performance tests

IS : 10000 Part IX Endurance tests

IS : 10000 Part X Tests for smoke levels, limits and corrections for smoke levels for variable speed engines

IS : 10000 Part XI Information required with inquiry or order and information supplied by the manufacturer with the engine

IS : 10000 Part XII Test certificates

This standard will be complementary to specifications for performance requirements of different types of engines covered by following standards:

- IS : 10001 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (up to 20 kW)
- IS : 10002 Specification for performance requirements for constant speed compression ignition (diesel) engines for general purposes (above 20 kW)
- IS : 10003 Specification for performance requirements for variable speed compression ignition (diesel) engines for automotive purposes
- IS : 10004 Specification for performance requirements for variable speed spark ignition engines for automotive purposes

Spark ignition engines for sprayers and similar applications have been covered by IS : 7347-1974 ' Specification for performance requirements of small size spark ignition engines for sprayers '.

Two-stroke spark ignition engines for automotive applications which were earlier covered by IS : 1603 will be covered by a separate specification.

The revised methods of tests covered by IS : 10000 have been aligned with the current international practices in the field of I. C. engines. These parts are in general agreement with the following ISO standards, issued by the International Organization for Standardization:

- a) ISO 3046/I-1975 Reciprocating internal combustion engines — Performance: Part I Standard reference conditions and declarations of power, fuel consumption and lubricating oil consumption
- b) ISO 3046/II-1977 Reciprocating internal combustion engines — Performance: Part II Test methods
- c) ISO 3046/III-1979 Reciprocating internal combustion engines — Performance: Part III Test measurements
- d) ISO 2710-1978 Reciprocating internal combustion engines — Vocabulary.

Although ISO has published ISO 3046/IV : Performance — Part IV Speed governing, our national committee has felt that at this time it may not be possible to align this standard with ISO 3046/IV because our national requirements differ from those given therein.

IS : 10000 (Part I to Part XII) and IS : 10001, IS : 10002, IS : 10003 and IS : 10004 collectively supersede IS : 1600-1960, IS : 1601-1960, IS : 1602-1960 and IS : 1603-1960.

TO

IS:10000(Part VII)-1980 METHODS OF TESTS FOR INTERNAL
COMBUSTION ENGINESPART VII GOVERNING TESTS FOR CONSTANT SPEED
ENGINES AND SELECTION OF ENGINES FOR USE
WITH ELECTRICAL GENERATORSCorrigenda

(Page 2, clause 2.3.3, informal table) - Substitute the following for the existing table:

<i>Governed Speed (At Full Rated Load)</i>	<i>Temporary Speed Change (Full Rated Load to No Load)</i>	<i>Maximum Permanent Speed Change (Full Rated Load to No Load)</i>
100 percent	15 percent	8 percent

(Page 2, clause 2.3.4, informal table) - Substitute the following for the existing table:

<i>Governed Speed (At Full Rated Load)</i>	<i>Temporary Speed Change (Full Rated Load to No Load)</i>	<i>Maximum Permanent Speed Change (Full Rated Load to No Load)</i>
Percent	Percent	Percent
100	15	8
80	17	10
60	20	13.3
50	25	16
40	30	20
30	40	27
25	50	32

Note - All the above values are as a percentage of the engine design speed.

(EDC 14)

TO

IS:10000(Part 7)-1980 METHODS OF TESTS FOR INTERNAL
COMBUSTION ENGINES

PART 7 GOVERNING TESTS FOR CONSTANT SPEED ENGINES
AND SELECTION OF ENGINES FOR USE
WITH ELECTRICAL GENERATORS

(Page 2, Note under clause 2.3.4) - Substitute
the following for the existing note:

'NOTE - All the above values are as a percentage
of the engine rated speed.'

(EDC 14)

Reprography Unit, BIS, New Delhi, India